METHOD AND APPARATUS FOR CONVEYING IMAGE ATTRIBUTES

FIELD OF THE INVENTION

The present invention relates generally to digital imaging and more specifically to techniques for conveying attributes of digital images in digital imaging devices and image display systems.

BACKGROUND OF THE INVENTION

Computer programs that display digital images often display them incorrectly because the programs do not take into account important attributes of the digital images. For example, such programs often display digital images in the wrong orientation. A rotated image results when the user of a digital imaging device rotates the device 90 degrees clockwise or counterclockwise from the standard landscape orientation during image capture. Displaying a rotated image in the correct orientation using image display software requires manual intervention by the user. Manual compensation becomes particularly burdensome for large numbers of images.

It is thus apparent that there is a need in the art for an improved method and system for conveying image attributes.

SUMMARY OF THE INVENTION

A method for conveying an attribute of a digital image is provided. A method for displaying a digital image in accordance with an attribute of the digital image is also provided. A digital imaging device, a system, and a computer-readable storage medium are also provided for carrying out the methods.

Other aspects and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1A is an illustration of a file name associated with a digital image in accordance with an illustrative embodiment of the invention.

Fig. 1B is an illustration showing how the case of the letters in the extension of a file name may be used to convey image attributes in accordance with an illustrative embodiment of the invention.

Fig. 2 is an illustration showing an example of how specific case combinations in the extension of a file name may be used to convey the orientation of an associated digital image in accordance with an illustrative embodiment of the invention.

Fig. 3A is a functional block diagram of a digital imaging device in accordance with an illustrative embodiment of the invention.

Fig. 3B is a conceptual diagram of a memory of the digital imaging device shown in Fig. 3A in accordance with an illustrative embodiment of the invention.

Fig. 4 is a flowchart of the operation of the digital imaging device shown in Fig. 3A in accordance with an illustrative embodiment of the invention.

Fig. 5 is an illustration of an image display system in accordance with an illustrative embodiment of the invention.

Fig. 6 is a flowchart of the operation of the image display system shown in Fig. 5 in accordance with an illustrative embodiment of the invention.

Fig. 7 is a conceptual diagram of a computer-readable storage medium in accordance with an illustrative embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Attributes of a digital image may be conveyed by encoding them using the case of letters in an extension of a file name associated with the digital image. Throughout this description, the "case" of a letter refers to any distinct manner in which that letter can be represented. The most common examples are upper case (capitalization) and lower case. However, the concept of case, in an electronic system such as a digital imaging device or a computing device, may be generalized to include other representations such as reverse video and blinking video, each of which may be combined with upper or lower case. Analogously, groups of words may be rendered in a variety of different cases such as upper case, lower case, title case, or sentence case.

Fig. 1A is an illustration of a file name 100 associated with a digital image in accordance with an illustrative embodiment of the invention. File name 100 comprises root portion 105 ("image") and extension 110 (".jpg"). Most computer operating systems define an extension 110 of a file name 100 as a suffix of root portion 105 comprising a period followed by one or more alphanumeric characters. In the example of Fig. 1A, extension 110 contains three letters 115 ("jpg") corresponding to the Joint Photographic Experts Group (JPEG) image compression format. Other common image-file extensions are ".gif" (Graphic Interchange Format) and ".tif" (Tag Image File Format). Depending on the computer operating system, extension 110 may have more or fewer than three letters 115.

Fig. 1B is an illustration showing how the case of the letters in extension 110 may be used to convey image attributes in accordance with an illustrative embodiment of the invention. Each of the eight file names shown in Fig. 1B has a different

combination of capitalization among the letters 115 in extension 110. In general, if each letter 115 may be represented in one of two cases, an *N*-letter extension 110 may be used to encode 2^N unique combinations. Each of these unique combinations (or a predetermined subset thereof) may be mapped to an attribute of the associated digital image. Examples of attributes include image orientation, color vs. black-and-white, color depth, double exposure, special effects present in the image, the location where the image was captured, and the device with which the image was captured. In general, an attribute is any characteristic of the digital image. Although the remainder of this description focuses on the attribute of image orientation, the principles of the invention may be applied to any other attribute of a digital image.

Fig. 2 is an illustration showing an example of how a set of case combinations in extension 110 may be used to convey the orientation of a digital image in accordance with an illustrative embodiment of the invention. In Fig. 2, each of four unique case combinations in extension 110 corresponds to a particular orientation of digital image 205. In this example, the extension 110 ".jpg" (all lower case) corresponds to a right-side-up landscape orientation (the reference orientation). The extension 110 ".Jpg" corresponds to an orientation in which digital image 205 is rotated counterclockwise by 90 degrees with respect to the reference orientation. The extension 110 ".jpG" corresponds to an orientation in which digital image 205 is rotated clockwise by 90 degrees with respect to the reference orientation. The extension 110 ".jPg" corresponds to an orientation in which digital image 205 is inverted with respect to the reference orientation. The particular mapping of case combinations to orientations shown in Fig. 2 is arbitrary and may be defined in a variety of other ways.

Those skilled in the art will recognize that an image that is rotated by 90 degrees in one sense or the other with respect to the reference orientation is produced when a digital imaging device is rotated by 90 degrees in the opposite sense during image capture. For example, a digital image 205 that is rotated by 90 degrees counterclockwise with respect to the reference orientation results when a digital imaging device is rotated by 90 degrees clockwise during image capture, and vice versa.

Fig. 3A is a functional block diagram of a digital imaging device 300 in accordance with an illustrative embodiment of the invention. Digital imaging device 300 may be a digital camera, a digital camcorder, a personal digital assistance (PDA), or any other device capable of capturing digital images. In Fig. 3A, controller 305 communicates over data bus 310 with imaging module 315, memory 320, input controls 325, display 330, and orientation detection subsystem 335. Optical system 340 produces optical images that are converted to digital images by imaging module 315. Imaging module 315 may comprise an array of photosensors based on charge-coupled-device (CCD) or CMOS technology, an analog-to-digital converter (A/D), a gain control, and a digital signal processor (DSP) (not shown in Fig. 3A). Input controls 325 may include navigational buttons (e.g., directional-arrow buttons), a menu or "ok" button, a shutter release button, or other controls, physical or virtual, for controlling the operation of digital imaging device 300. Orientation detection subsystem 335 may detect the orientation of digital imaging device 300 during image capture. Such orientation detection or tilt detection subsystems are well known in the art. For example, orientation detection subsystem may be based on accelerometer technology. Orientation detection subsystem 335 may be configured to detect whether digital imaging device 300 is in the reference orientation (right-side-up

landscape) during image capture or whether the device is rotated 90 degrees clockwise or counterclockwise with respect to the reference orientation.

Fig. 3B is a high-level conceptual model of memory 320 in accordance with an illustrative embodiment of the invention. Memory 320 may further comprise both random access memory (RAM) 345 and non-volatile memory 350. Non-volatile memory 350 may, in some applications, be of the removable variety (e.g., a solid-state multi-media card). Functionally, memory 320 may also include, in RAM 345 and/or non-volatile memory 350, module encode attribute 355. Module encode attribute 355 comprises control logic to encode an attribute of a digital image 205 using the case of letters 115 in the extension 110 of a file name 100 associated with digital image 205, as explained in connection with Figs. 1A, 1B, and 2. In one embodiment, module encode attributes 355 comprises stored program instructions in firmware that are executed by controller 305. In general, the functionality of module encode attributes 355 may be embodied in any combination of hardware, firmware, or software.

Fig. 4 is a flowchart of the operation of digital imaging device 300 in accordance with an illustrative embodiment of the invention. At 405, orientation detection subsystem 335 detects the orientation of digital imaging device 300 relative to the reference orientation. At 410, digital imaging device 300 captures a digital image 205. At 415, module encode attributes 355 encodes the orientation of digital image 205 using the case of letters 115 in the extension 110 of a file name 100 associated with digital image 205. At 420, the process terminates.

As explained above, the sense of rotation of digital imaging device 300 during image capture is opposite that of the resulting rotation of digital image 205 when a rotated digital image 205 is produced. Therefore, encoding the orientation of digital image 205 at step 415 may be implemented in at least two ways: (1) to indicate the

rotation of digital imaging device 300 during image capture or (2) to indicate the resulting rotation of digital image 205. As long as consistency is maintained with image display programs interpreting the encoded orientation in extension 110, either implementation is viable.

Fig. 5 is an illustration of an image display system 500 in accordance with an illustrative embodiment of the invention. Image display system 500 may be a personal computer, laptop computer, notebook computer, PDA, smart phone, or any other device capable of displaying digital images. Image display system 500 may display a digital image 205 in accordance with attributes encoded using the case of letters 115 in the extension 110 of a file name 100 associated with the digital image 205.

Fig. 6 is a flowchart of the operation of image display system 500 in accordance with an illustrative embodiment of the invention. At 605, image display system 500 reads a file name 100 associated with a digital image 205. The case of letters 115 in extension 110 of file name 100 is interpreted at 610 as an encoded attribute of digital image 205. At 615, image display system 500 displays digital image 205 in accordance with the encoded attribute. At 620, the process terminates.

One example of displaying digital image 205 in accordance with an encoded attribute is compensating for the rotation of digital image 205 in order to display the image in its correct orientation. For example, if digital image 205 has an associated file name 100 "image.Jpg" indicating that digital image 205 is rotated 90 degrees counterclockwise relative to the reference orientation (see Fig. 2), image display system 500 may compensate by rotating digital image 205 by 90 degrees in the clockwise sense to display digital image 205 right side up.

Fig. 7 is a conceptual diagram of a computer-readable storage medium 700 containing program code in accordance with an illustrative embodiment of the invention. Computer-readable storage medium may be a magnetic disk, optical disc, floppy disk, tape, solid-state memory, or any other medium for storing electronic data and/or program instructions. Computer-readable storage medium 700 comprises three code segments. First code segment 705 reads a file name 100 associated with a digital image 205. File name 100 includes extension 110 comprising at least one letter 115. Each letter 115 in extension 110 may be represented in one of at least two possible cases. Second code segment 710 interprets the case (e.g., capitalization or lack thereof) of the letters 115 as an encoded attribute of digital image 205. Third code segment 715 causes digital image 205 to be displayed in accordance with the encoded attribute. In one embodiment, image display system 500 reads and executes the program code contained on computer-readable storage medium 700.

The foregoing description of the present invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and other modifications and variations may be possible in light of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and various modifications as are suited to the particular use contemplated. It is intended that the appended claims be construed to include other alternative embodiments of the invention except insofar as limited by the prior art.